DEVELOPMENT OF NANOCRYSTALLINE SOFT MAGNETIC MATERIALS BY MELT-SPINNING AND/OR MECHANICAL ALLOYING

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Finemet, Hitperm and Nanoperm alloys containing bcc-Fe nanocrystallites are of interest as soft magnetic materials [1]. As an example, the substitution of small amounts of Co or Ni for Fe in Fe-based magnetic materials generally results in an increase of saturation magnetization [2]. Furthermore, soft magnetic materials with magnetotransport properties have an outstanding relevance in the competitive field of technological devices. The actual activity of our group concerns the development of nanocrystalline and amorphous alloys by the melt spinning (MS) and mechanical alloying (MA) techniques, to establish the structural stability, to search for the influence of the particle-size effects in the magnetic properties and to analyze the effect of the different elements introduction [3]. The construction of crystallization transformation diagrams allows us to design thermal treatments [4].

The balance between cold welding and fracturing in MA materials is controlled by the addition of a surface additive, a process control agent (PCA). Several PCAs such as: hexane, polyethylene glycol, cyclohexane, stearic acid, cyclopentane, pentanone, naphthalene and hexanone were used. The results indicate that PCAs produce considerable effects on the particle size as well as on the structural behaviour and thermal stability of the as milled powders, if compared with material synthesized without surfactant. We develop materials with higher thermal stability front crystalline growth [5].

In other way, The MA of bulk amorphous glasses is a two-step procedure prior to the consolidation or compacting in the powder metallurgy industry. Furthermore, ball-milling experiments with iron-based amorphous alloys have shown the possibility for a mechanical driven crystallization with average crystallite sizes about 10 nm [6].

Finemet and Fe(Co,Ni)-Nb(Zr)-B-Cu alloys are being produced. Stable nanostructures have been obtained in a wide temperature range, because the processing conditions have been optimized. The Mössbauer spectroscopy has turned into one of the key techniques in the structural and magnetic characterization of the Fe-based alloys.

Actually, we are analyzing Fe based materials developed by mechanical alloying and melt spinning in order to obtain and characterize nanocrystalline materials with magnetotransport properties. In the new project, our intention is to develop nanowires in collaboration with other research groups.

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